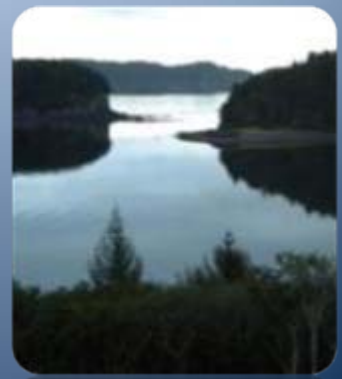


Water, Food, and Sustainable Livelihoods

Steven Murawski, Ph.D.
National Oceanic and Atmospheric Administration | NOAA
May 6, 2010
Roundtable on Science and Technology for Sustainability – National Academy of Sciences

Outline

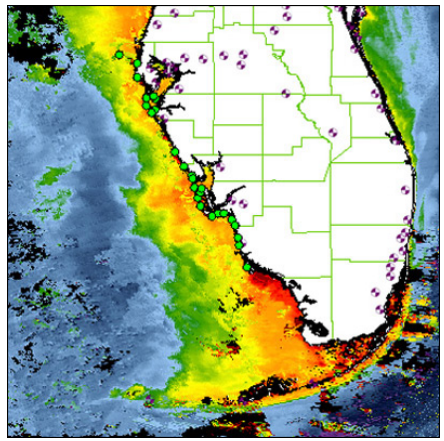
- ✓ The nexus between people, the water environment and food supply – operational definitions of sustainability
- ✓ A Broad View of the Global Sustainability Challenge – The Millennium Assessment
- ✓ The Value of Environmental Information…..an economic weapon
- ✓ The Roles of Science and Technology in Achieving Sustainability

Sustainability in the Water-Food-Livelihood Domain – Interactions at the Triad

People (happy & safe)

Impacts of People on Populations & Populations on People

Environmental Forcing and Impacts on Coastal Communities



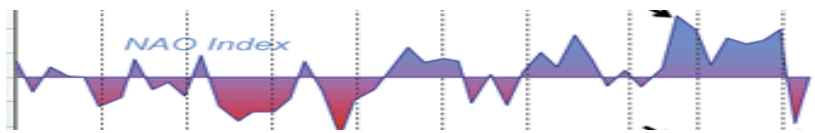
Habs, SLR, Storms, Oil Spills Etc.

Working Definitions of Sustainability

Food Production (ex. Fisheries)

(abundant)

Impacts of Environmental Variation on Regulated Animal Populations



Environment

(productive & safe)

Goals for the Sustainability Triad

- **People:** Understand and predict how people effect and are affected by interactions with the environment, natural habitats and the livelihoods in coastal and ocean ecosystems
- **Environment:** Comprehend how conditions in the marine environment and their variability influence natural ecosystems and human communities
- **Animals:** Quantify and predict the relative effects of human interactions and fluctuations in the environment on the abundance, recruitment and sustainability of animal populations, species communities and ecosystems, particularly those under the stewardship of the USG.

Grand Societal Challenge

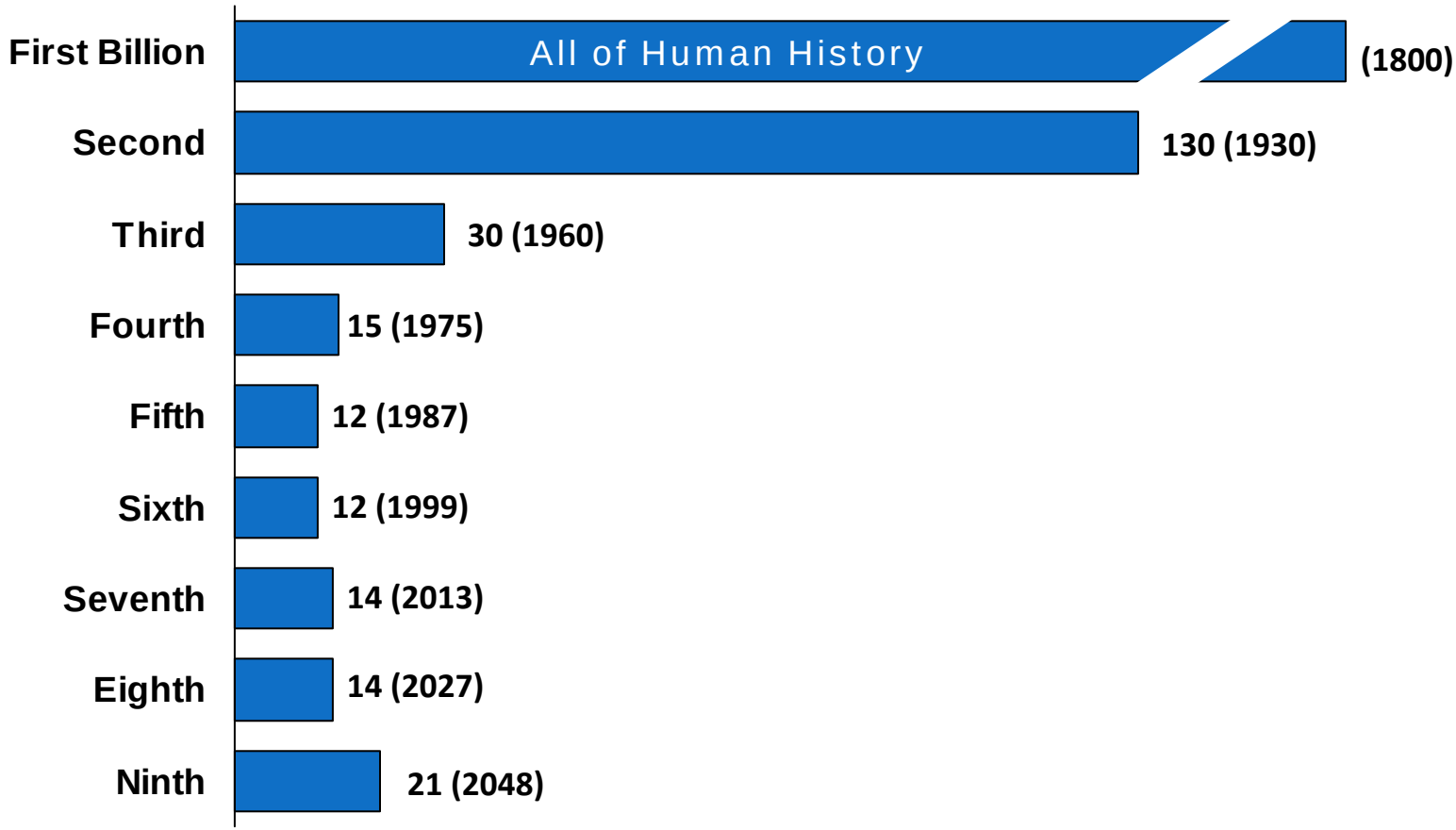
Improve Human Well-Being While Restoring the Planet's Life Support System

Millennium Development Goals

1. End Poverty & Hunger
2. Universal Education
3. Gender Equality
4. Child Health
5. Maternal Health
6. Combat HIV/AIDS
7. Environmental Sustainability
8. Global Partnership

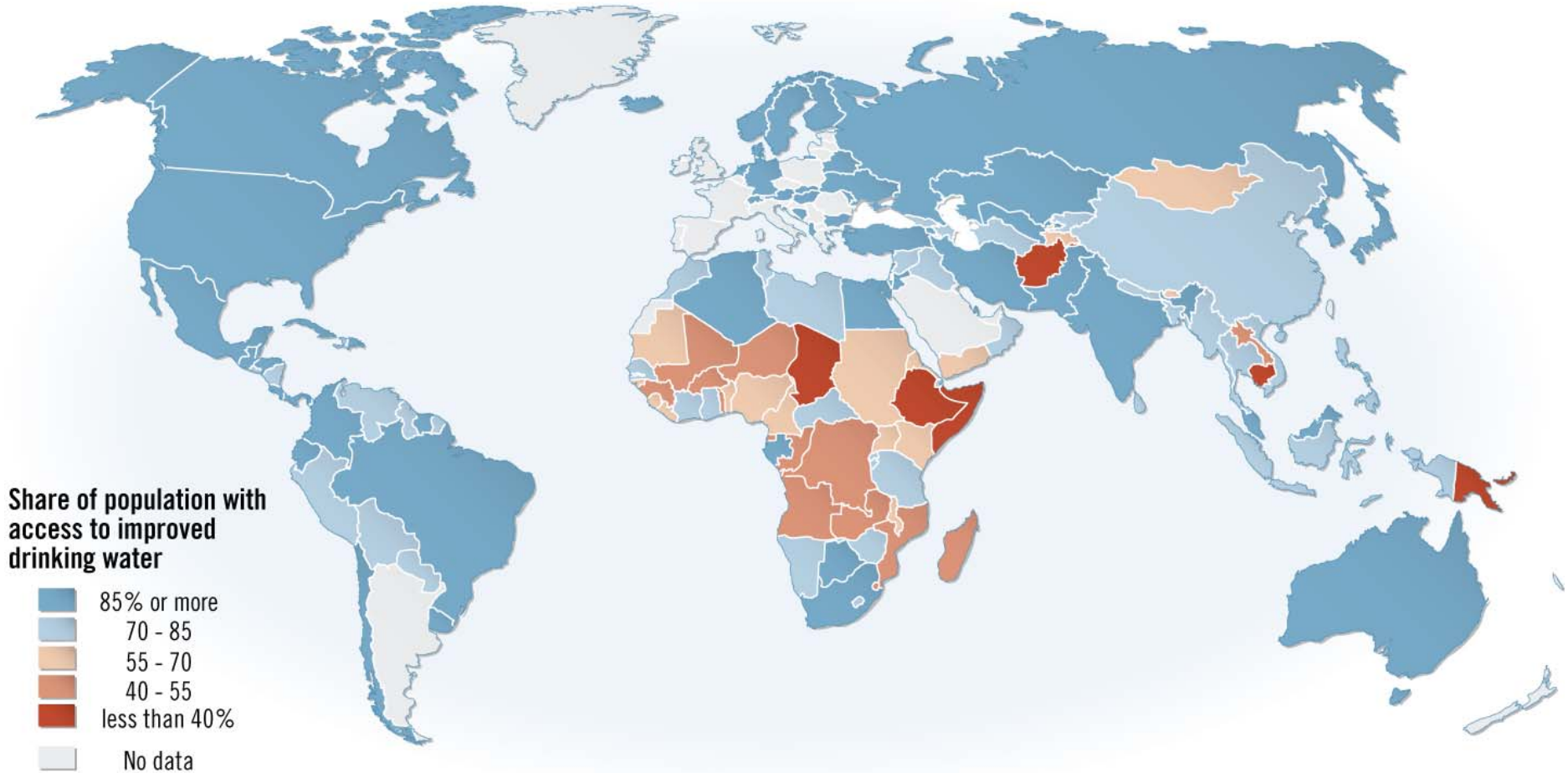
World Population Growth:

Number of Years to Add Each Billion (Year)



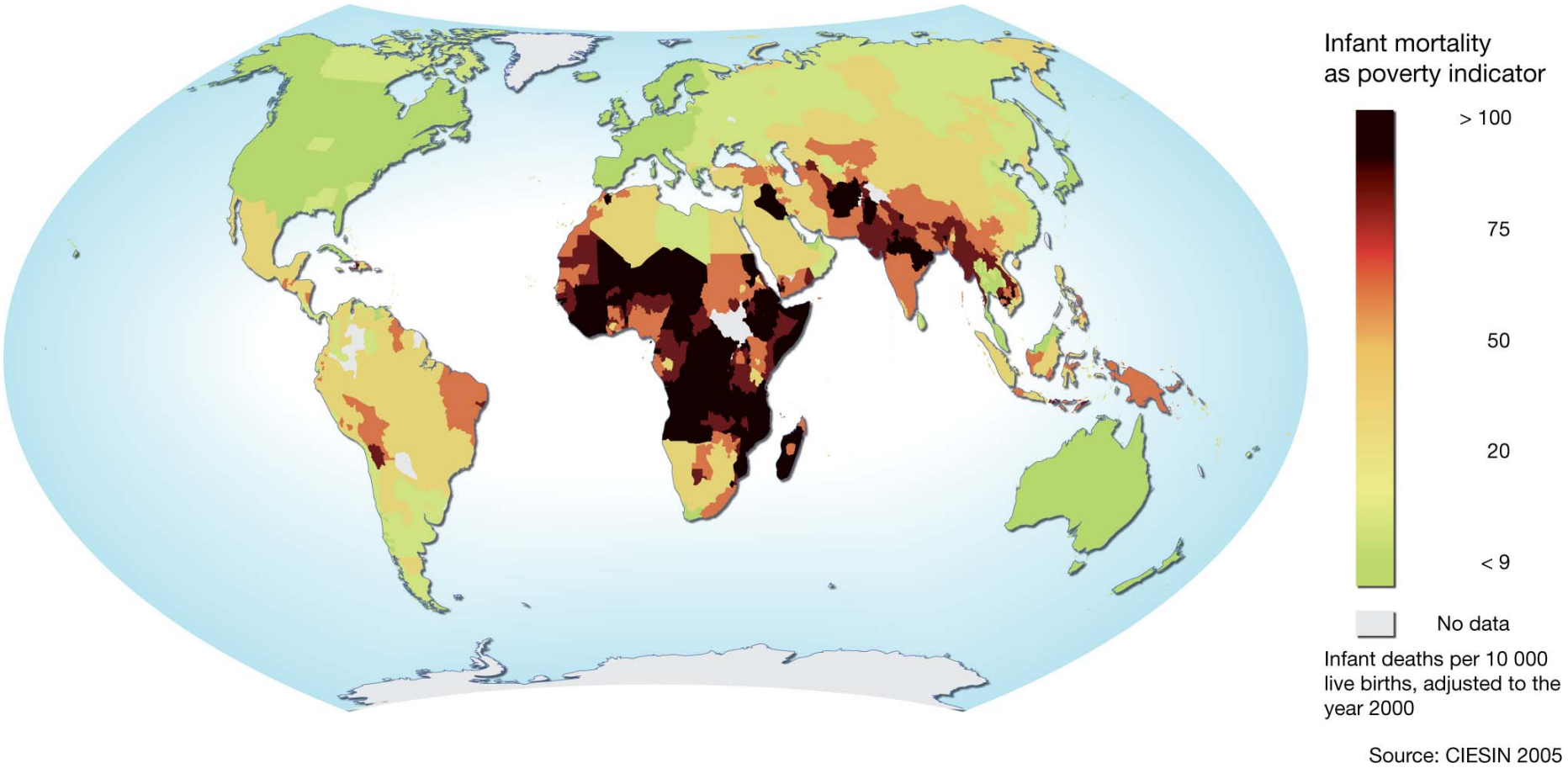
Sources: First and second billion: Population Reference Bureau. Third through ninth billion: United Nations, *World Population Prospects: The 2004 Revision* (medium scenario), 2005.

Access to Safe Drinking Water



Source: World Health Organization and UN Children's Fund

World Poverty Distribution

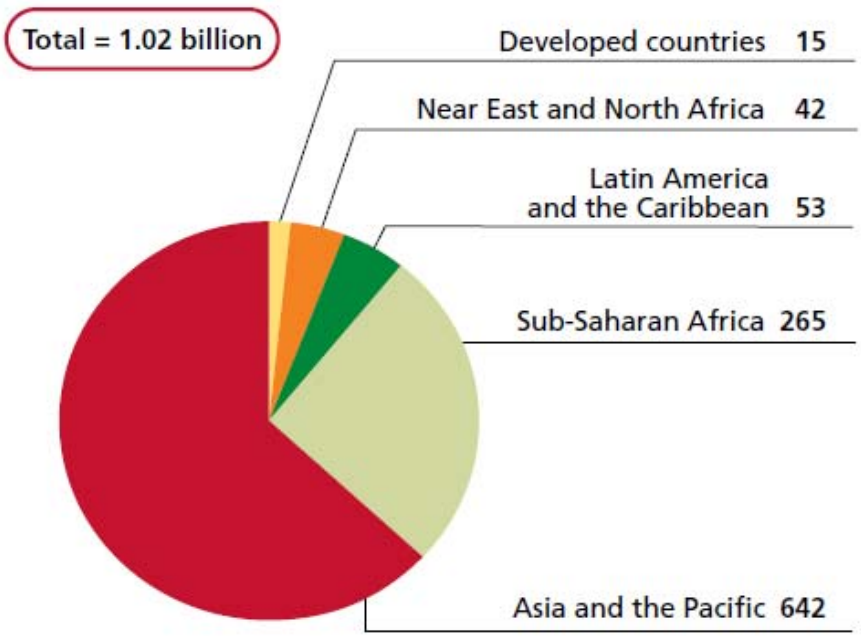


Source: Center for International Earth Science Information Network, Columbia University

Over one billion people are undernourshed

FIGURE 4

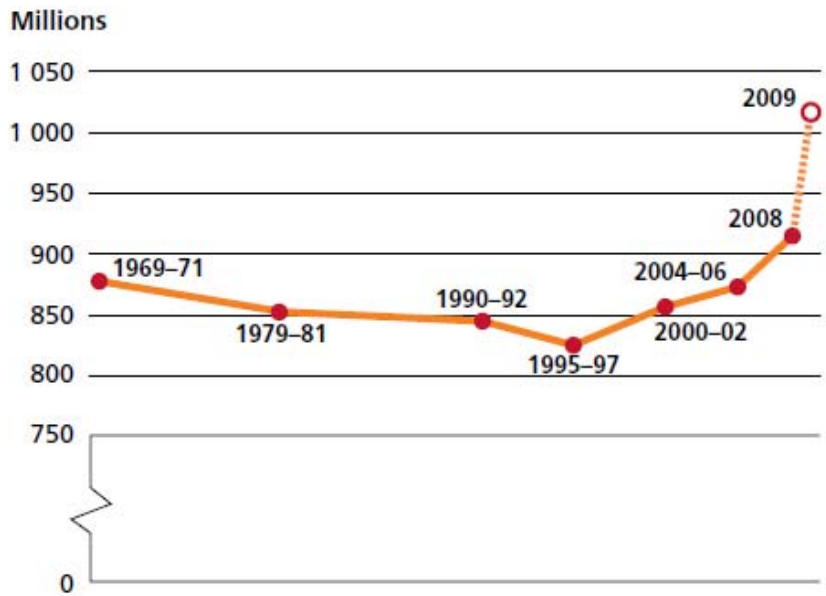
Undernourishment in 2009, by region (millions)



Source: FAO.

FIGURE 5

Learning from the past: number of undernourished in the world, 1969–71 to 2009

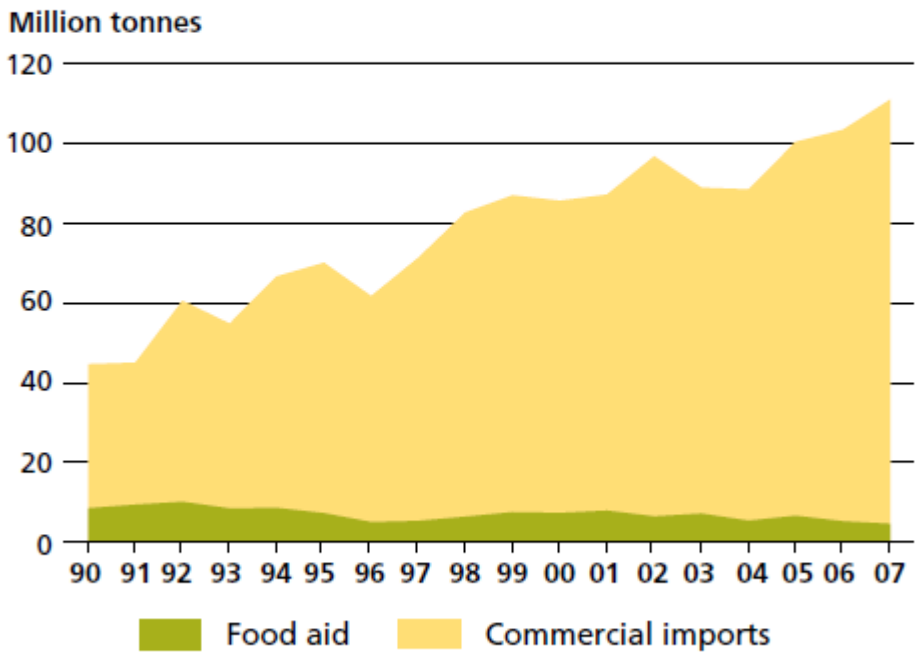


Source: FAO.

Globalization of the Food Economy

FIGURE 13

Developing countries have become increasingly dependent on food imports: grain imports in 70 countries



Note: Data refer to 70 developing countries comprising the model used by the USDA Economic Research Service for its Food Security Assessments.

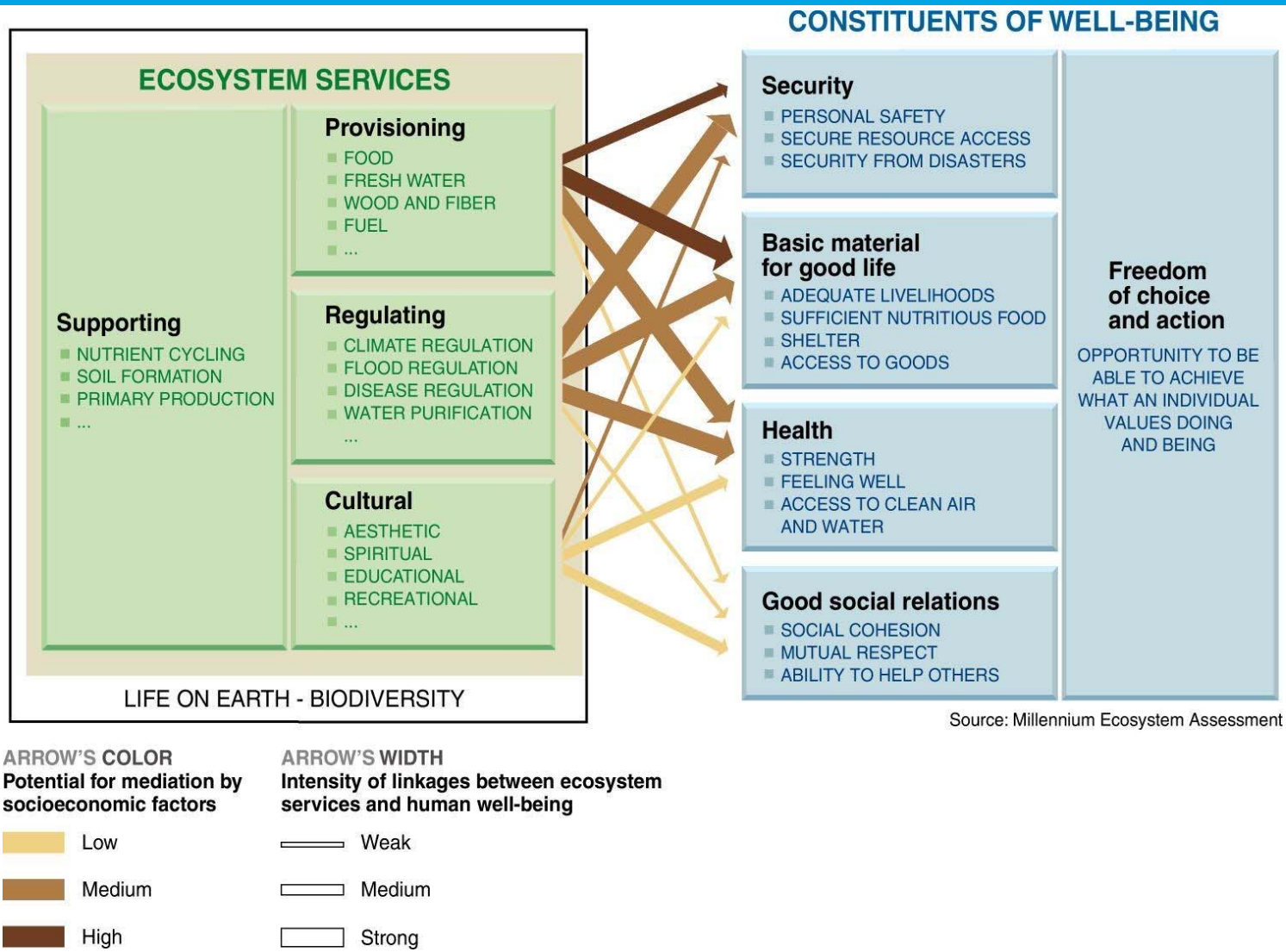
Source: FAO.

Achieving the MDGs

- **Millennium Development Goals (MDG):** Current efforts reflect a sequential approach

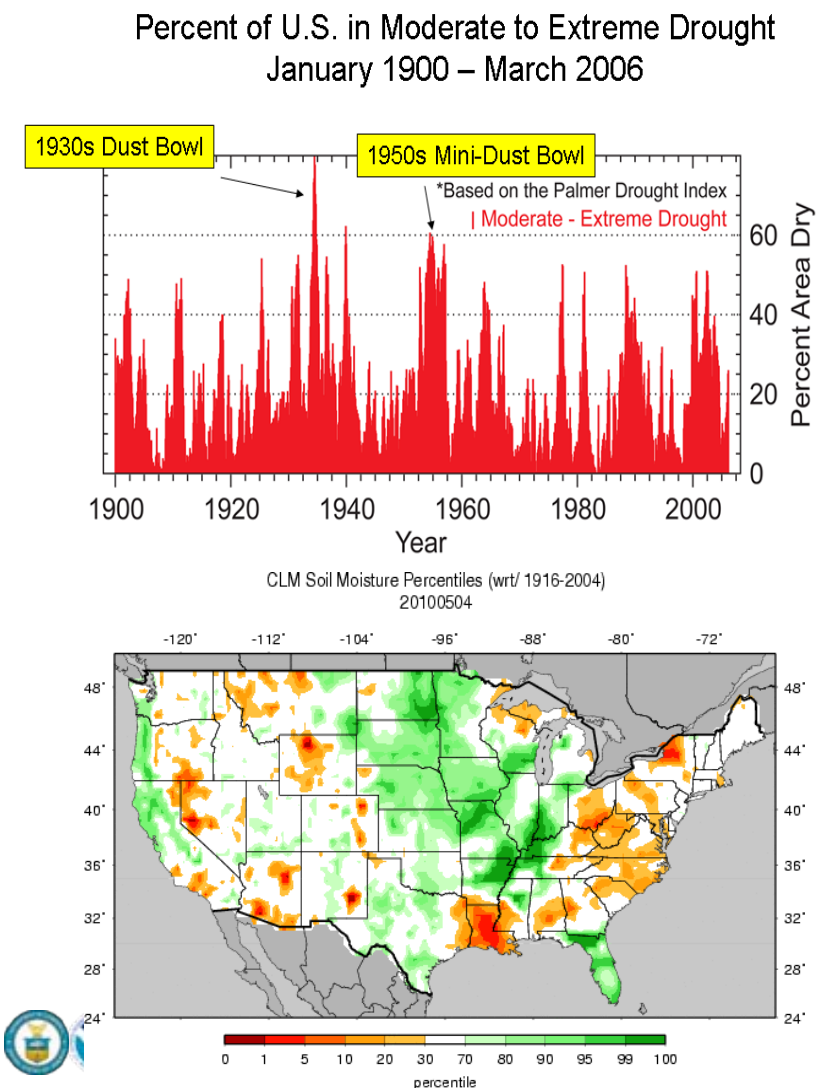
- **Millennium Ecosystem Assessment:** MDG goals can only be achieved if they are solved simultaneously

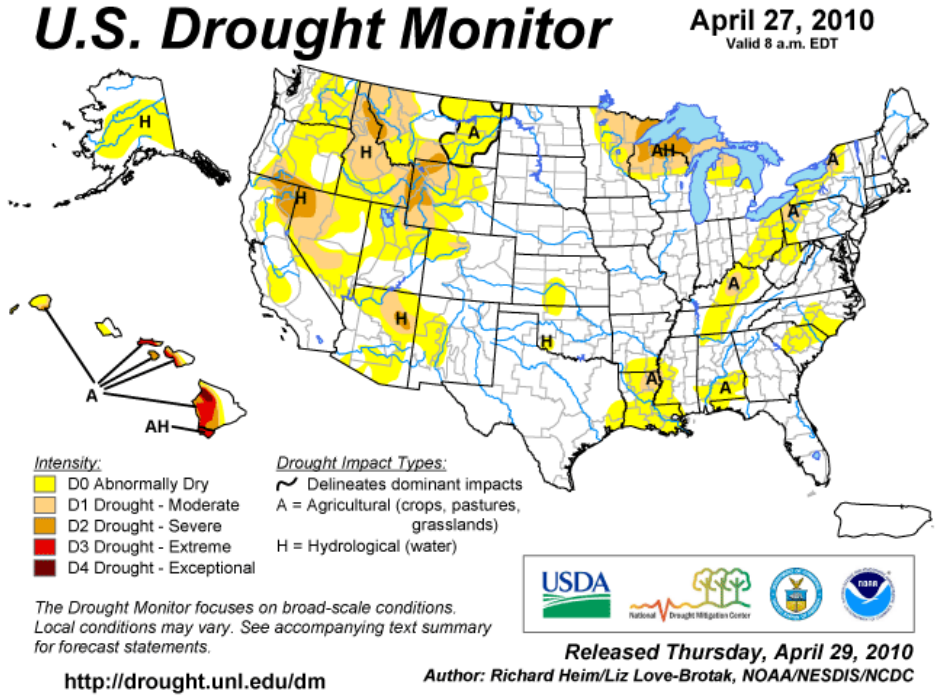
Millennium Ecosystem Assessment



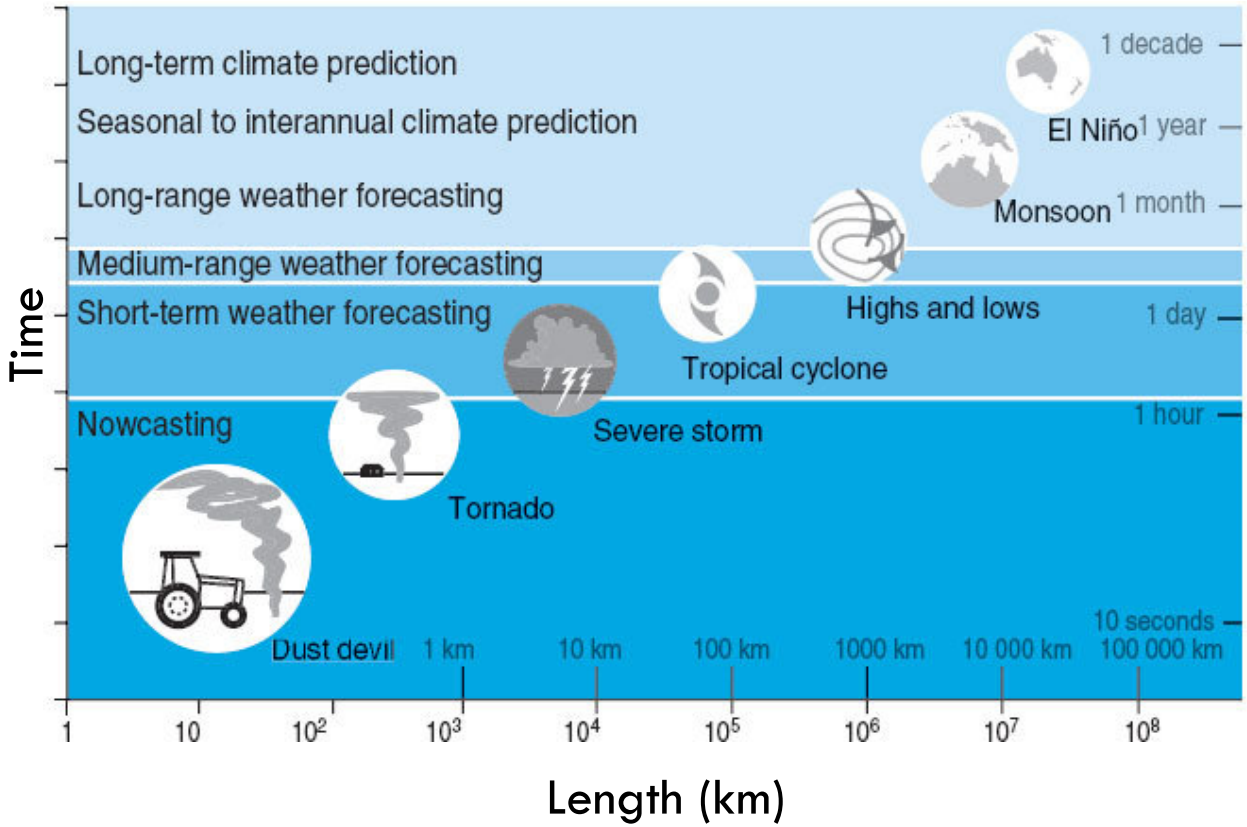
Source: Millennium Ecosystem Assessment

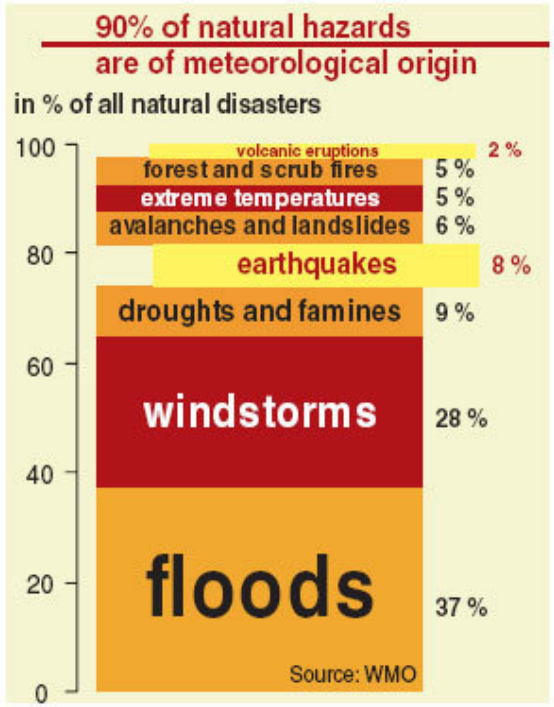
Access to Environmental Information an Economic Advantage





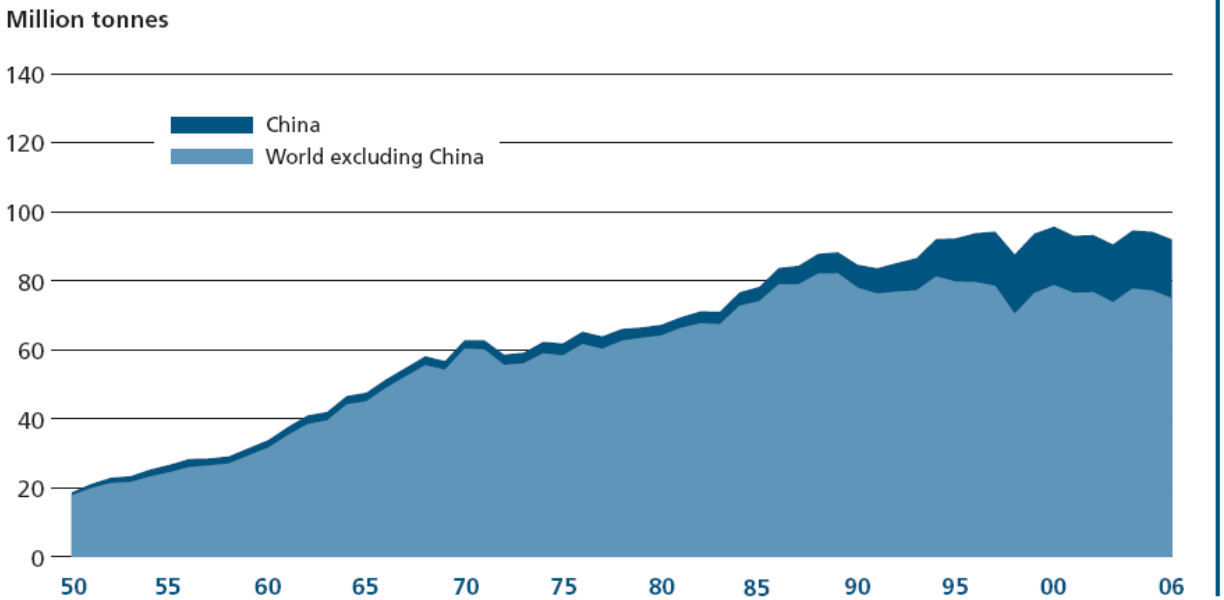
Early Warning Systems





Source: WMO

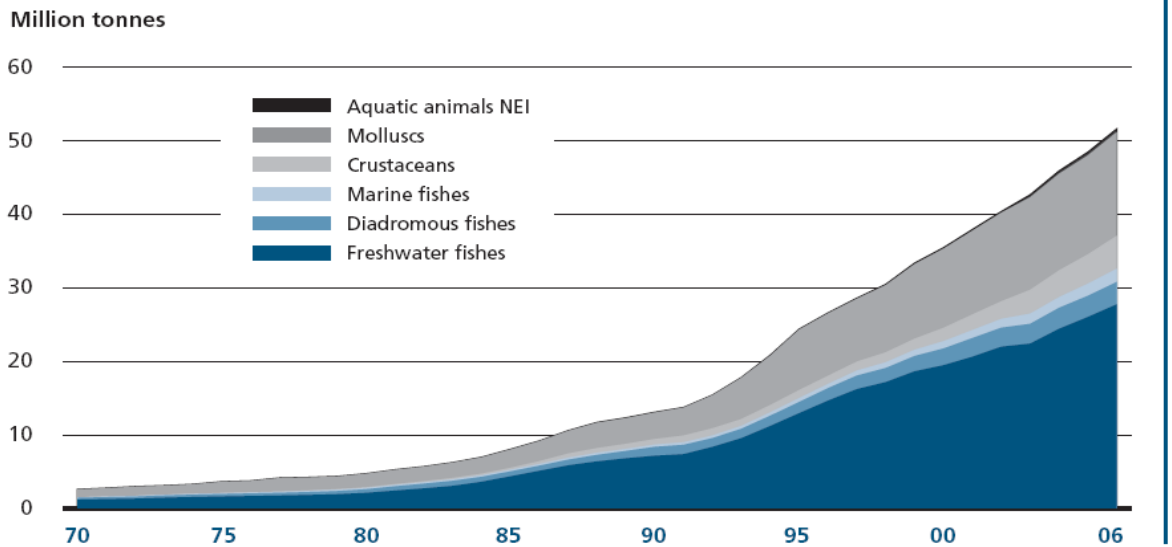
World capture fisheries production



Wild Fisheries are Flat

Aquaculture is Growing

Trends in world aquaculture production: major species groups



How much fish in the future

2006 –

- Capture fisheries stabilized at 85-95 mmt.
- Aquaculture ~ 40 mmt and increasing
- 33 mmt used for oil and animal feed, rest consumed.

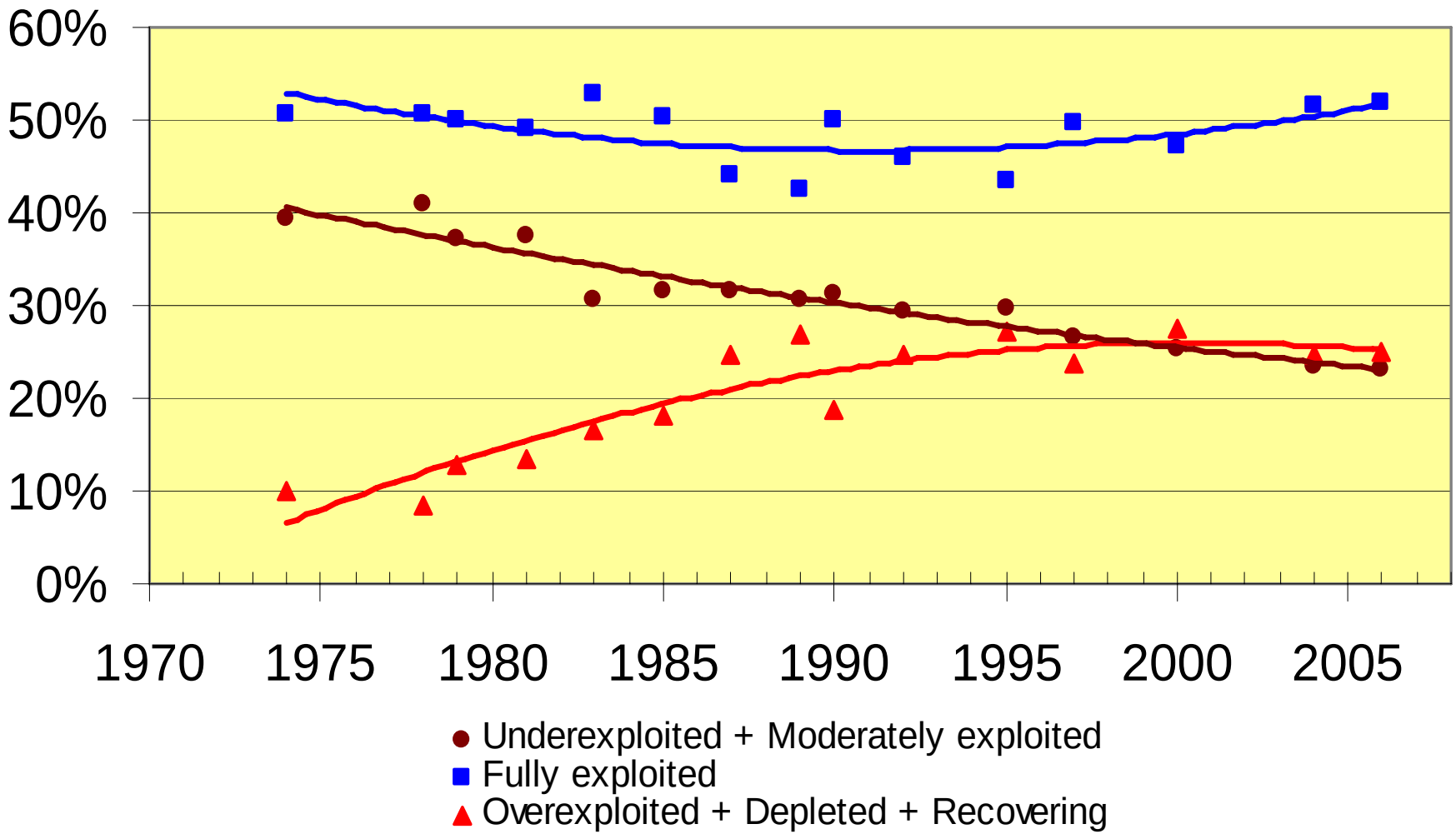
2050 –

- If fish stays 20% percent of dietary protein, 20% of 365 mmt = **73 mmt tonnes MORE fish**

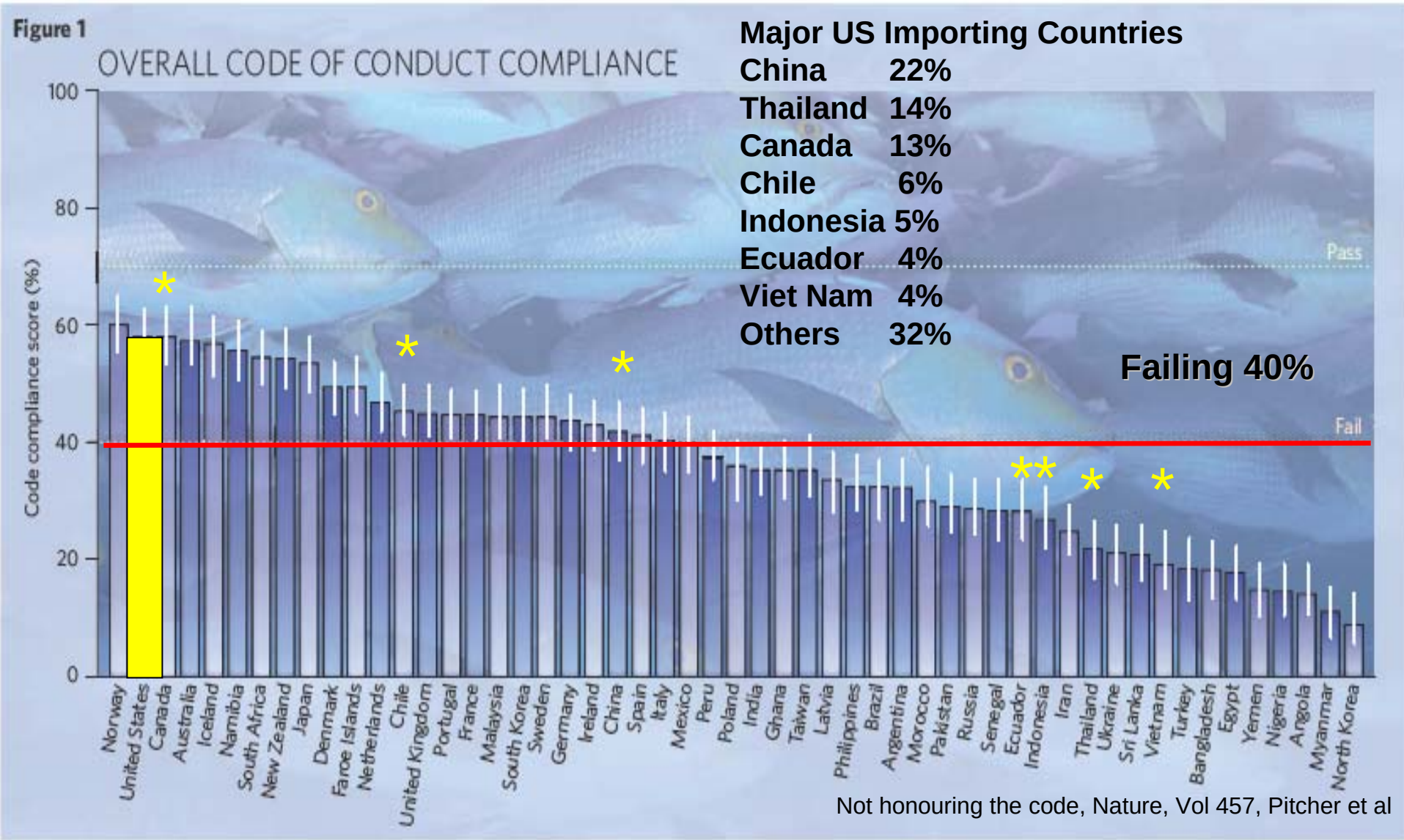
If it has to replace decreasing grain–**MORE**

With most of population growth in parts of world where fish is greater % of protein- **EVEN MORE**

Global trends in the state of world marine fish stocks since 1974



State of Global Fisheries



Major US Importing Countries

China	22%
Thailand	14%
Canada	13%
Chile	6%
Indonesia	5%
Ecuador	4%
Viet Nam	4%
Others	32%

Failing 40%

Not honouring the code, Nature, Vol 457, Pitcher et al

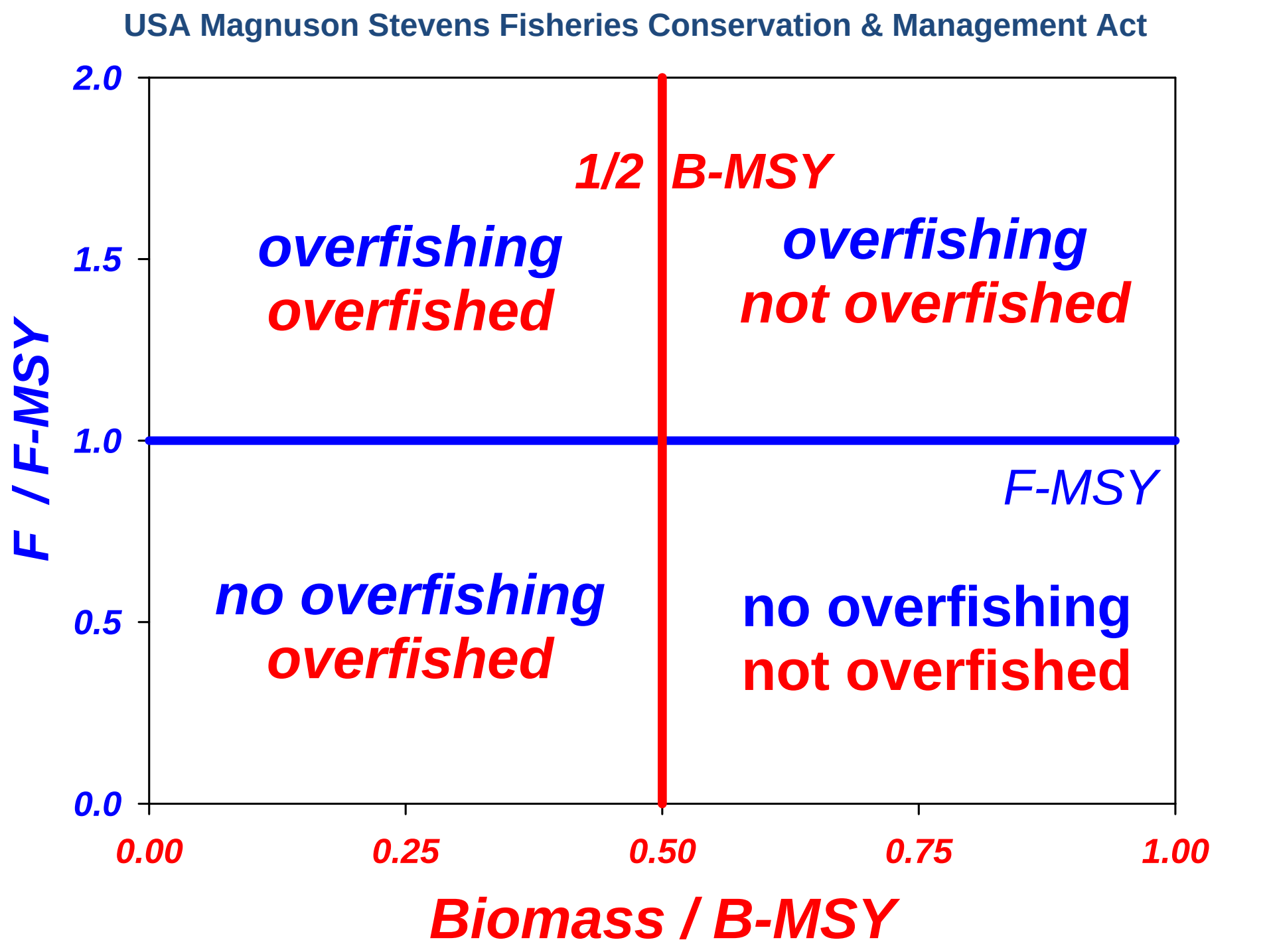
Operational Definitions Sustainability in USA Resource Management – ex. fisheries

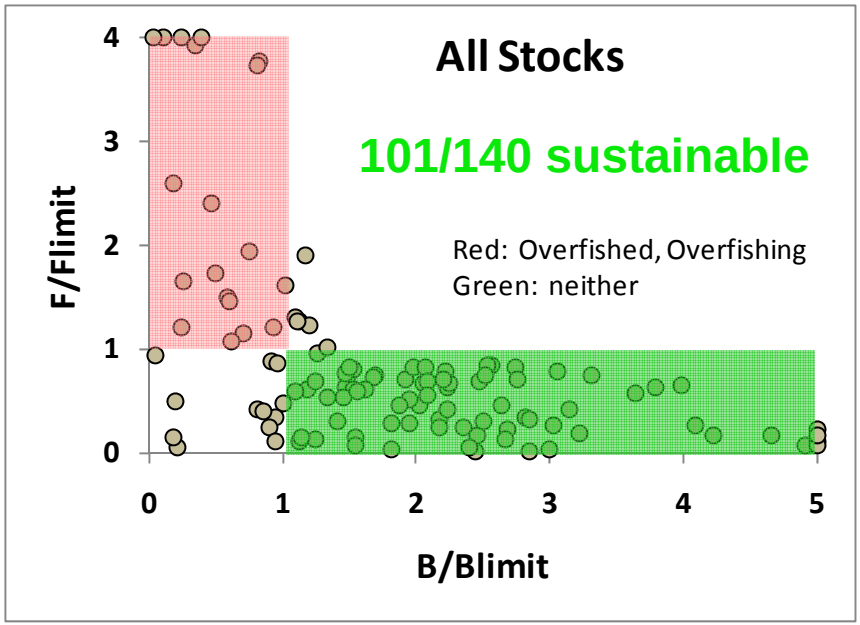
Overfishing: The RATE of harvest (percent of the stock removed by fishing) exceeds the pre-defined maximum rate (generally about 20% per year is sustainable) – F-limit

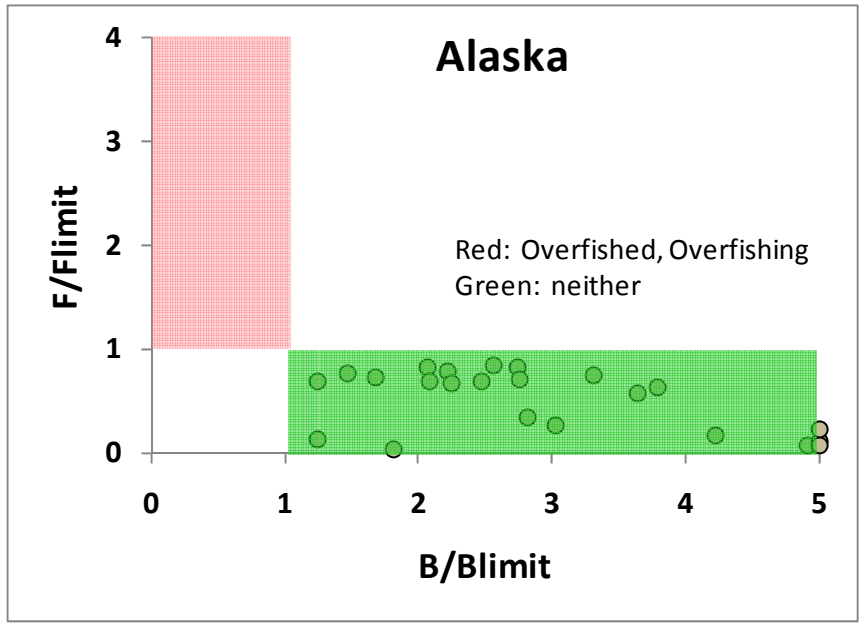
Overfished: The current SIZE of the population is less than ½ of the population size required to generate maximum sustainable yields B-limit

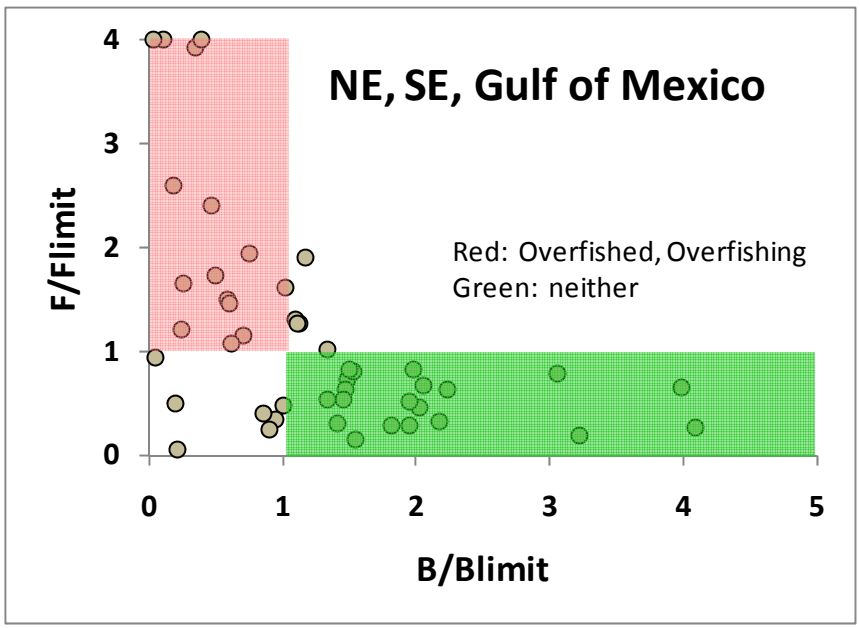
If the rate of outflow exceeds the rate of inflow, the use rate is not sustainable

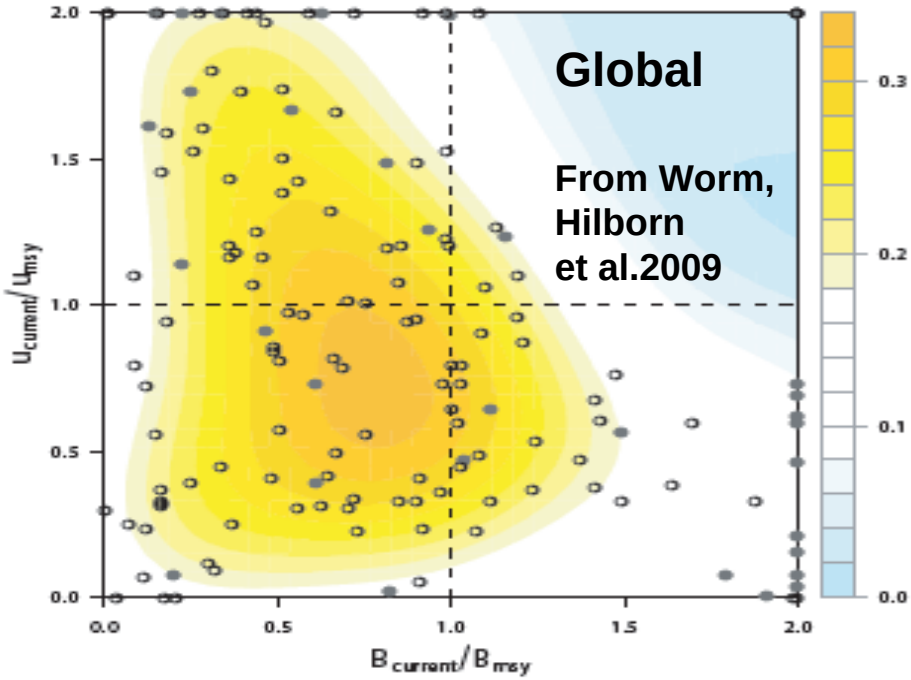
If the glass ½ full or less the water supply is overused


USA Magnuson Stevens Fisheries Conservation & Management Act
2.0
1.5
1.0
0.5
0.0
F / F-MSY
1/2 B-MSY
overfishing
overfished
overfishing
not overfished
F-MSY
no overfishing
overfished
no overfishing
not overfished
0.00
0.25
0.50
0.75
1.00
Biomass / B-MSY


All Stocks
101/140 sustainable
Red: Overfished, Overfishing
Green: neither
F/Flimit
B/Blimit
0
1
2
3
4
5


Alaska
Red: Overfished, Overfishing
Green: neither
F/Flimit
B/Blimit
0
1
2
3
4
5


NE, SE, Gulf of Mexico
Red: Overfished, Overfishing
Green: neither
F/Flimit
B/Blimit
0
1
2
3
4
5

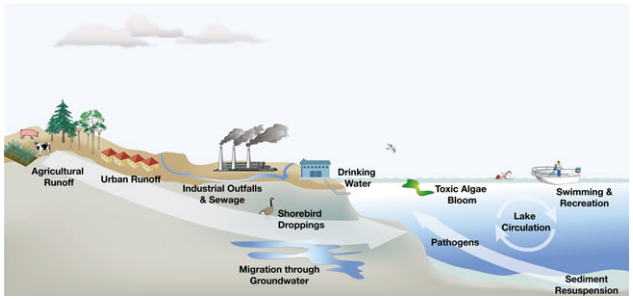

Global
From Worm, Hilborn et al.2009
U current/ U msy
B current/ B msy
0.0
0.5
1.0
1.5
2.0
0.3
0.2
0.1
0.0

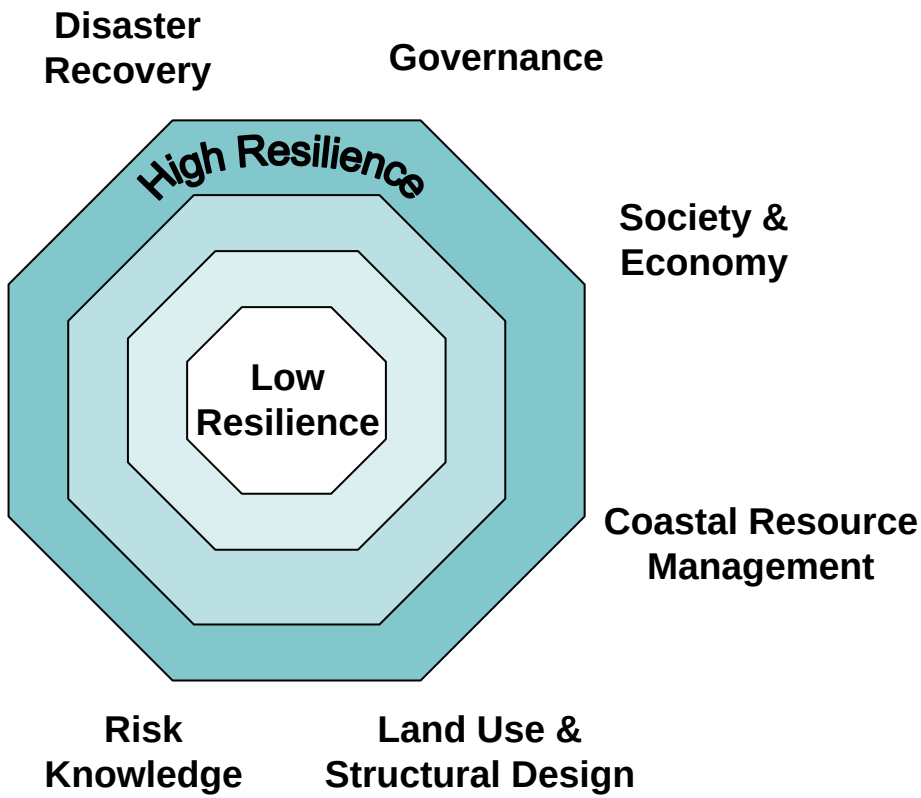
Meeting Seafood Demand – Creating more value

- 80% of USA consumption is imported, half of that is from aquaculture
- Rising food prices in general, unique challenges for seafood – poor carbon footprint, rising cost of fuel for capture fisheries
- Legislative & scientific challenges for sustainable aquaculture
- Creating more asset value for domestic fisheries – new instruments, risk reduction strategies -- Catch Shares, LAPPs, markets

Are Sustainable Ecosystems Consistent with Sustainable Economies?

Elements of Coastal Community Resilience (Sustainability)





INTEGRATED COASTAL MANAGEMENT

Disaster Management Framework	Coastal Management Framework
Mitigation	Assessment & Planning
Preparedness	Implementation
Response	Monitoring & Evaluation
Recovery	Governance
	Education & Outreach

What Do Citizens Want?

HEALTHY SEAFOOD

CLEAN BEACHES

ABUNDANT WILDLIFE

GOOD JOBS

VIBRANT COASTAL COMMUNITIES

RENEWABLE ENERGY RESOURCES

STABLE FISHERIES

Defining Environmental Sustainability
Some Grand Challenges

- Numerous Indicators of environmental condition (e.g., Coastal Condition Report, etc.) But no agreed-upon definition of environmental sustainability.

- Need dedicated work on the relationship of indicators to adaptive environmental Management (e.g., DPSIR Framework -Drivers, Pressures, State, Impact, Response)

- Defining cumulative impacts and environmental “tipping points” (e.g., how many docks in an estuary is too many?)

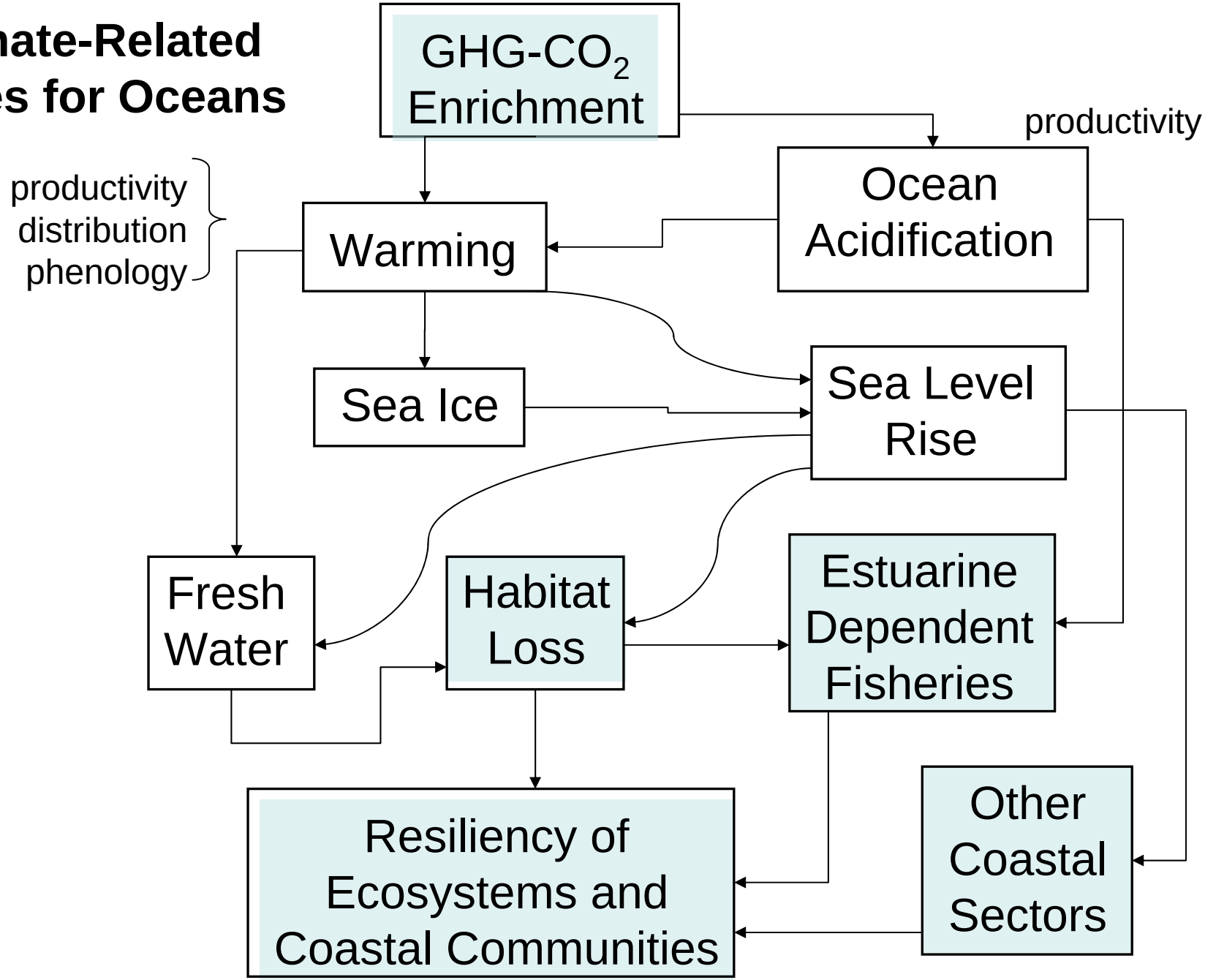
- Connectivity of offshore (oceanic) and nearshore (coastal) ecosystems and the role of protected areas in sustaining ecological function

- Determination of the relative importance of coastal habitats as a basis to prioritize protection and acquisition (which areas should be protected first?)

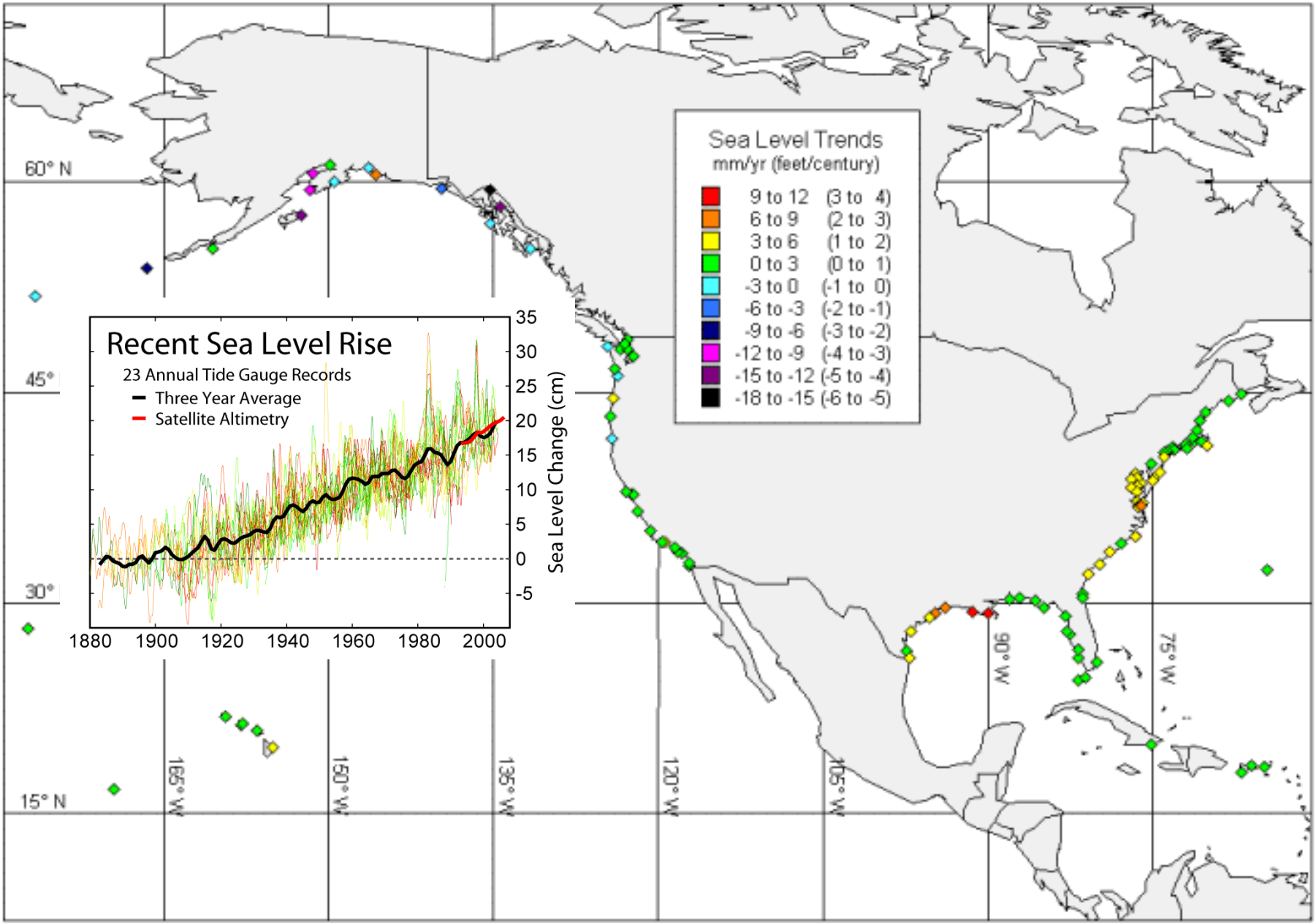
Grand Challenges in Understanding Long-Term Trends in Environmental Forcing & Climate Change

- Attribution of climate signals impacting ecosystems: long term change vs. natural variability –stationarity?
- Ocean warming: impacts on distribution & productivity (phenology, production, invasives), human diseases
- Impacts of loss of sea ice on living marine resources (at both poles)
- Ocean acidification impacts on marine biota
- Freshwater supply & resource management
- Sea level rise (natural resources & coastal communities)

Climate-Related Issues for Oceans



Trends in Sea Level Rise & Resource Impacts



Key role of science & technology

- Science provides the *foundation* for credible decision-making
- *Science serves society* by helping us understand:
  - How the world works
  - How it is changing
  - Implications for people
  - Likely consequences of different policy options
  - Viable solutions

" A Vision without resources is an hallucination"

Pentagon, as Cited by Tom Friedman in H-F-C